Project Name: Green Horse

Supporting information includes a description of what resource indicators measure, methodology for assessing project activity effects to water resources, a brief description of existing condition, a description of how data was collected for this project, and the input variables and outputs for water yield and sediment models. For model calculations, the spreadsheets with input values for ECA calculations and for the NEZSED model are included in the Project Record. Presenting the results and the interpretation of the results is the primary focus of the Effects Section in the Environmental Assessment though some interpretation is included for the WEPP results, particularly for roads.

1.1 RESOURCE INDICATORS

Water Quantity and Quality:

The balance of water yield and sediment yield in a watershed influences the water quantity and water quality of a stream system. Water quantity also described as water yield refers to stream flow quantity and timing and is a function of water, soil, and vegetation interactions. Changes in amount or distribution of vegetation can affect water yield and ultimately alter stream channel conditions. Although there are no Federal, State of Idaho, or Forest Plan standards governing increases in water yield, there is general guidance on thresholds (NOAA 1998, Gerhardt 2000, USDA Forest Service 1973). Equivalent Clearcut Area (ECA) analysis is a tool used to correlate the relationship between water yield and the extent of forest canopy openings from fire, harvest, and roads.

Active erosion of the landscape yields sediment to streams and occurs naturally. When an excess of sediment—that is, over the natural (balanced) amount—is delivered to a stream, the stream's ability to route the sediment out of the system is diminished, and water quality is reduced. Harvest, temporary road construction, prescribed fire, and road-related activities have the potential to increase erosion production and sediment delivery into streams.

Roads influence both water quantity and quality. Roads concentrate surface water and are a source of sediment entering streams. Watershed road densities >3 miles per square mile (mi/mi^2) are categorized as low condition (i.e., poor conditions for watershed resources) (NOAA 1998).

Metrics for Assessing Resource Indicators that May be Used:

- Percent increase in ECA for 6th level, HUC12 subwatersheds (compare to thresholds in NOAA 1998)
- Percent increase in ECA for Forest Plan Prescription watersheds (compare to guidance limiting increase in ECA to 20-25%, Gerhardt 2000)
- Percent sediment yield increased over base (natural), as modeled by NEZSED for Forest Plan Prescription watersheds
- Sediment yield estimates as modeled by WEPP for base conditions and for increases as a result of project activities.
- Watershed road miles (HUC 12, Forest Plan Prescription watersheds)

Table 1. Resource Indicators and Metrics Used to Evaluate Water Resource Effects

Resource Element	Resource Indicator	Measure Described (Quantify if possible)	Measure
Water Yield	Equivalent Clearcut Analysis (ECA)	• Proposed acres of harvest and roads will increase the potential water yield measured by percent change of ECA	• Percent Increase in ECA per HUC 12
Water Quality	Sediment Yield	• Modeled Sediment Yield over base levels for HUC 14 (7th Level HUC Watersheds) for all combined actions (harvest, fuels, and roads) • Evaluation of potential sedimentation from roads used for project activities. Models or qualitative. WEPP, GRAIP, NEZSED • Quantify Risk Factors: Crossings, LSP, RHCA, Slope	• Percent increase in sediment yield over base erosion rates compared to Forest Plan Guidelines or Base levels • Description of field evaluations of road sedimentation potential • Miles of roads in RHCAs • Number of Stream Crossings • Description of model output and roads on landslide prone terrain

1.2 Analysis Methodology

The overarching goal of the Effects Analysis is to understand how the existing condition of streams and watersheds may change as a result of project activities. And, most importantly, whether that change will be the difference between the quantity or quality of the resource moving from a good or acceptable condition to a state that result in diminished ability of the watersheds to support the identified desired uses. Uses may include drinking water, state or federally defined beneficial uses of the water body, aquatic habitat, and riparian function.

The spatial boundaries for the Effects Analysis are Subwatersheds (HUC 12) where project activities occur or smaller watershed or catchments if that scale is desired for understanding effects. USGS watersheds are part of the Watershed Boundary Dataset and the different levels are based on the number of digits in their Hydrologic Unit Code (HUC). NEPA analyses will focus on the HUC12 Subwatersheds, affected by proposed project activities. HUC 12 Watersheds typically range between 10,000 to 40,000 acres. The Clearwater National Forest and Nez Perce National Forest Plan (1987) prescription watersheds are generally 3rd to 5th order streams and the Forest Plans require some sediment analysis to complete at the scale of the prescription watershed-usually smaller than the scale of a HUC 12 (7th Level HUCs).

GIS-generated reports and maps, aerial photos, and field reviews were used to analyze effects to water quality and quantity from the proposed activities. Resource condition observations were conducted in the field during August of 2020.

A schematic for methodology follows.

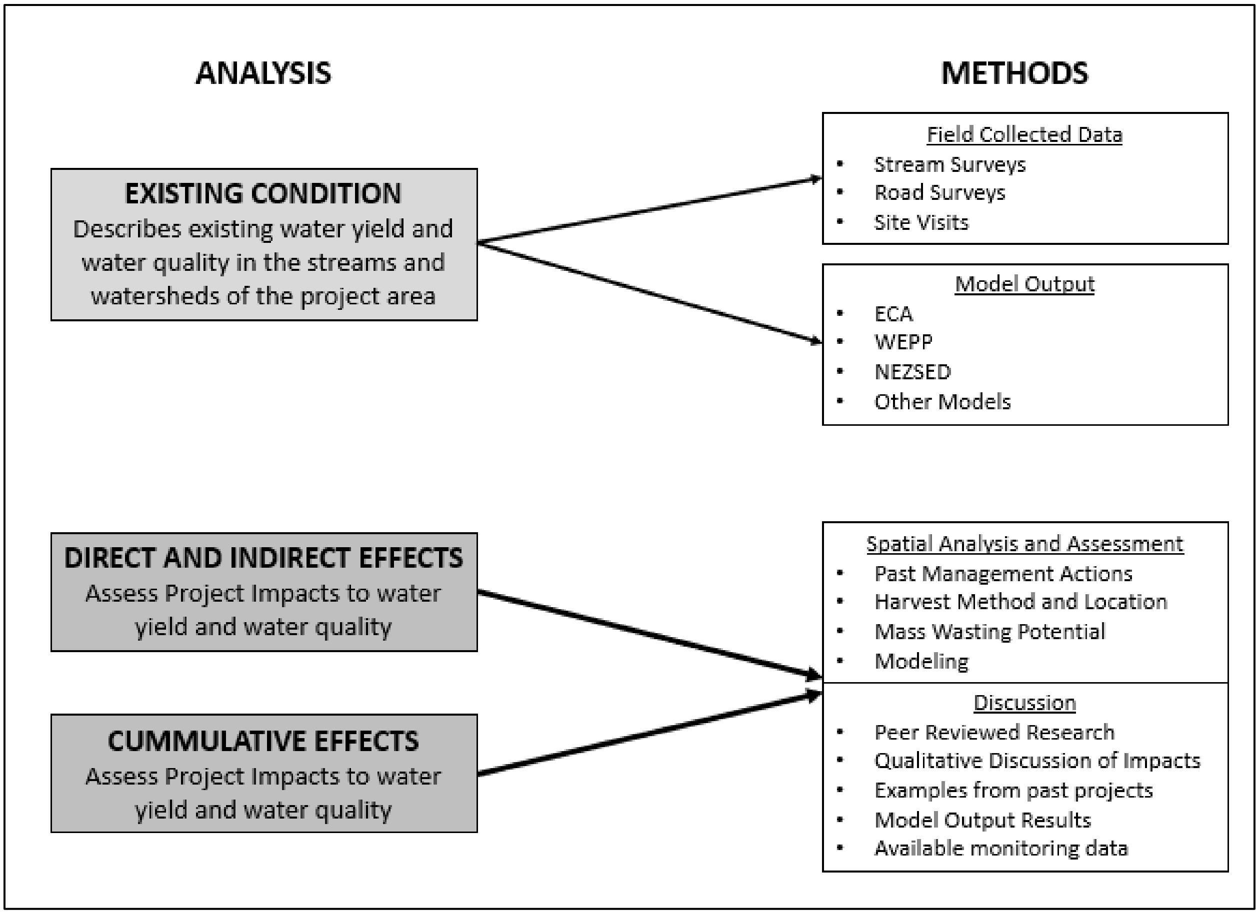

Figure 1. Schematic showing methodology tools to complete parts of the NEPA Effects Analysis

1.2.1 Field Data Collection

Field visits for Green Horse included data collection a combination of the following types of data. An x indicates the data was collected during site visits.

_x_ Stream Habitat Condition Surveys: Stream habitat data include a collection of metrics to indicate sediment loading including percent surface fines and cobble embeddedness, metrics to indicate riparian habitat condition including large woody debris and vegetation cover, and metrics to evaluate channel stability. Protocols generally follow Clearwater National Forest stream survey protocols as detailed in the 2014 white paper (CNF 2014). And, also some adaptations from the PACFISH/INFISH Biological Opinion Monitoring Program (PIBO) monitoring protocols and the effectiveness implementation strategy (Kershner et al 2004). Stream habitat data is used to determine existing condition of sediment loading and to understand potential impacts from project actions.

__Headwater channels, ephemeral swales, and springs/seeps in the proposed treatment units and downstream of them were examined and recorded on a map. Evaluations of these sensitive habitat types are used to determine project impacts and help identify where avoidance and mitigation measures should be carefully implemented.

_x_Road and culvert surveys. Survey protocols focus on assessing current condition of System and Non-system roads. Assessments will be used to determine locations where road improvement such as added drainage features (water bars, cross drains, additional culverts or upsized culverts, surfacing) will reduce potential sedimentation from roads into waterways or to inform a prescription for non-system roads that are no longer needed as a part of the transportation system. Data collected includes culvert size, location of erosion features like rills and gullies, ditch condition, depth of fill, stream crossing condition, etc.

_x_ Unit Walk Through. Visiting areas with proposed activities provides a better way than models to predict and understand potential impacts to water quality and water quantity. For proposed harvest and fuels projects walking through the units helps the Hydrologist understand where projects will mostly likely impact water quality and quantity. Key factors to note in a walk through survey on the NPC: % slope, soil type and landtype (ash cap present?), climate regime, topography such as dissected terrain with numerous steep draws, or shallow slopes, seeps or riparian/wetland areas, landslide risk factors, vegetation type and forest floor condition, and proximity to channels (ephemeral, intermittent, and perennial).

Additional Information Sources to Evaluate Existing Condition. Used when indicated by an x.

_ Forest stand database (FSVeg) queries were conducted to identify past harvest activities and the time frame during which they occurred. Results of FSVeg spatial queries are used to analyze existing condition and the data is available in the Project's spatial file database.

__The Selway and Middle Fork Clearwater Rivers Subbasin Assessment (USDA Forest Service 2001) and from the was used to develop the existing condition and cumulative effects evaluation.

1.2.2 Modeling Effects to Resource Indicators

Several analysis tools and models may be utilized to calculate resource indicator values in order to compare to threshold levels designated in Forest Plans. Models provide estimates, not absolutes, for comparison of alternatives. Not all Effects Analysis included in the NEPA documents will incorporate every model described below. The models used will be referenced in the NEPA document under the Effects descriptions. This section will provide a more complete background and description of the models, project model inputs and outputs, and sources and/or estimates of error.

1.2.2.1 Water Yield by Equivalent Clearcut Area (ECA)

<u>Model Description</u>: Equivalent Clearcut Area analysis is a tool used to index the relationship between vegetation condition and water yield from forested watersheds. The ECA model evaluates vegetation removal and the resulting potential changes to stream flow, timing, and water yield. The ECA analysis for this project utilized treatment and recovery coefficients from Ager and Clifton (2005) to determine existing and percent increase in ECA at the HUC12 and, in some analyses, Forest Plan Prescription watershed scales. Because harvest and burn history were not available for private or state lands, size and date of forest openings were determined using NAIP imagery in ArcGIS and Google Earth software.

The ECA model was developed in Region 1 of the Forest Service to analyze the effects of timber harvest and road construction on average annual water yield. The method was developed in the early 1970s by research scientists and several Region 1 Forest Service hydrologists and culminated in the publication Forest Hydrology - Hydrologic Effects of Vegetation Manipulation, Part II (USDA Forest Service 1973). Early guidance for vegetation management recommended that ECA not exceed 20-25% in third to fifth order drainages (Silvey 1973). Recent literature has converged upon a 20% change in forest canopy as commonly producing a detectable change in peak flows and/or average annual water yield and recommends water yield/peak flow analysis should be assessed at no greater than the HUC12 (i.e. 6th code HUC) scale, if not also at a finer resolution as deemed appropriate by the scope of the proposed project and potential risks downstream (e.g. – water intake, ESA species present). (MacDonald and Stednick 2003; Grant et al. 2008, Troendle et al. 2010).

When the ECA model was developed and during the time that many paired watershed studies on clearcut harvesting were conducted, general forest practices included clearcutting with no retention trees; larger harvest units; distinct, linear unit edges; harvest right up to stream channels; higher severity slash removal burns (site prep); and different Best Management Practices than are used today.

Studies by Belt (1980) and King (1989) have served as field tests of the ECA procedure. Belt concluded that the ECA procedure is a rational tool for evaluation of hydrologic impacts of forest practices on third to fifth order drainages, which are typically similar in size or smaller than current HUC12 subwatersheds. King recommended local calibration of the model and a greater emphasis on conditions in first and second order headwater streams.

The Matrix of Pathways and Indicators of Watershed Condition for Chinook, Steelhead, and Bull Trout is an analysis tool adopted by federal agencies to describe the condition and function of many watershed processes (NOAA1998). ECA is one of several indicators used in the matrix. High quality habitat is associated with ECA of less than 15% in a HUC10 watershed and all internal HUC12 subwatersheds, moderate quality is associated with 15-20% ECA in HUC10 watersheds, with one or more internal HUC12 subwatersheds at 15-30% ECA, and low quality is associated with ECA of greater than 20% in a HUC10 watershed, with one or more internal HUC12 watersheds at greater than 30%.

Results: The results of the ECA calculations are presented in the Effects Analysis. The calculation data and spreadsheet with inputs is included in the project file: GH_ECA_Final_20200311.

1.2.2.2 Channel Stability Evaluation (not done for Green Horse)

Channel Stability ratings require a Rosgen Channel Classification for evaluated streams and then, sensitivity to disturbance ratings and associated recovery potential ratings are assigned (Rosgen 1994 and Rosgen and Silvey 1996). The streams may also be evaluated using the Stream Reach Inventory and Channel Stability Evaluation Guide (USDA FS 1975, Pfankuch 1975). Channel Stability rates serve to categorize how resistant streams are to recent flow forces and the capacity of streams to adjust and recover from potential changes in flow and/or increases in sediment production.

1.2.2.3 Flow and Watershed Characteristics (not done for Green Horse)

USGS StreamStats is a tool to compute ungagged stream flow information and stream reach characteristics and flow calculations. Where available Forest monitoring data may be used to explain channel flow characteristics and ranges of flows.

1.2.2.4 WEPP (Watershed Erosion Potential Prediction) Modules

Model Description: The WEPP models typically used are ERMiT, GEOWEPP, Disturbed WEPP, WEPP Watershed Online, and WEPP:Road. The physical basis and performance of the WEPP models is discussed in the model documentation (Elliot *et al.* 2000, Elliot 2004, Robichaud *et al*. 2007), as well as several peer-reviewed papers (Elliot 2004, Laflen *et al*. 2004, Larsen and MacDonald 2007).

The WEPP model is designed to predict sediment yield resulting from various forest management activities and the probability of sediment delivery, erosion, and runoff. The Disturbed WEPP erosion model (Elliot et. al. 2000), and WEPP:Road (Elliot et al. 1999) were used to predict the level of erosion and sediment delivery produced from hypothetical "average" harvest, prescribed burning, temporary road construction and road improvement activities. The WEPP model is designed to predict sediment yield resulting from various forest management activities and the probability of sediment delivery, erosion, and runoff. The values obtained from the hypothetical "average" activities is best used to compare the magnitude of difference between alternatives rather than provide an accurate quantified sediment yield.

WEPP Inputs for modules include soil texture, vegetative cover, slope percent and slope length, and climate. The strongest controls on WEPP predicted erosion are changes in vegetative cover, slope length, and climate; for each Disturbed WEPP run, climates are customized for the subwatershed based using PRISM data for the location of project activity.

1.2.2.5 NEZSED

- Base Sediment Levels – the natural erosion rates for each watershed derived from landtypes and included in NEZSED variables.
- Past Activities-Acres and location of previous harvest in each watershed and prescribed fires.
- Proposed Actions-include harvested area by prescription (regeneration, intermediate) and harvest system (ground, cable, etc) and proposed burn acres by burn prescription.
- Past Wildfire-Acres of recent wildfire and severity that may be contributing to existing sedimentation from each watershed.
- Existing Roads- existing road system. Sedimentation from roads is calculated on a watershed-scale (not a segment by segment scale). Controls on sedimentation rates are design characteristics (surfacing, width, grade), hillslope, landtype, etc.
- Project Roads- additional project related sediment is added from existing roads which have proposed reconstruction, reconditioning, and temporary road construction that is outside the proposed units (temporary roads within the units are factored in the NEZSED values for ground-based harvest systems)

Sediment yield is calculated for base conditions (without management activities), current conditions (cumulative of past and existing management activities combined with base conditions), and predicted conditions (cumulative of past, existing, and proposed activities combined with base conditions) for each of the proposed project alternatives. These percentages of sediment yield over base conditions are then compared to the sediment yield guidelines for prescription watersheds listed in Appendix A of the Forest Plan. Disturbance entries or the numbers of large activities in a decade are also calculated to compare with guidelines established in Appendix A of the Forest Plan. Modeling was done on a peak year basis in order to meet the assumptions under which Appendix A of the Nez Perce Forest Plan was developed. It is highly unlikely, however, that all of the activities proposed would occur in a single year.

1.2.3 Modeling Inputs and Outputs

1.2.3.1 WEPP Modules

Green Horse WEPP Inputs: In 2017, the Nez Perce Clearwater National Forest contracted Rocky Mountain Research Station and WEPP model Developer, Dr. Bill Eliot to complete a sedimentation analysis using WEPP modules for the proposed Clear Creek Integrated Restoration Project. The write up for the modeling effort, Elliot and Miller 2017, provides an excellent guide for selecting input variables for WEPP simulations on the Central Zone of the Nez Perce Clearwater National Forest (NPC). The variables selected for this project are based on the assumptions in Elliot and Miller 2017.

Subwatershed: Glover HUC 12 (Falls Creek Forest Plan) Units:18-20 Soil Type: Silt Loam

Treatment	WEPP Silt Loam Soil Category File and Management File	Ground Cover (Percent)
Undisturbed Forest	Mature Forest	100
Skyline Logging	Mature Forest	90
Tractor Logging	Shrub	80
Jackpot Burning	Low severity fire	90
Broadcast Burning	Low severity fire	85

Table 2. **WEPP Input Variables for the Green Horse Project**

WEPP Outputs (if used for the Project)

User inputs

Location	**ElkCityID +** Modified by Rock:Clime on August 31, 2020 from FENN RS ID 103143 0 T MAX 35.45 42.78 50.69 61.34 70.27 78.31 88.83 88.66 76.43 60.78 44.95 36.85 deg F T MIN 22.73 26.78 30.14 35.15 41.30 47.68 51.17 50.14 44.09 36.55 30.74 25.51 deg F MEANP 3.72 2.64 2.86 2.70 3.24 3.10 1.48 1.59 2.06 2.07 3.00 3.41 in # WET 16.17 13.18 15.06 13.52 12.96 11.47 5.93 6.11 7.64 9.84 15.00 15.50 days Latitude 45.83 Longitude 115.44 Elevation 4605.0 ft				
Soil texture	clay loam				
Element	**Treatment**	**Gradient (%)**	**Length (ft)**	**Cover (%)**	**Rock (%)**
Upper	mature forest	0 30	50	100	20
Lower	mature forest	30 5	50	100	20
Description					

Mean annual averages for 30 years

			Total in 30 years	
33.51	in.	precipitation from	4240	storms
0.20	in.	runoff from rainfall from	12	events
0.80	in.	runoff from snowmelt or winter rainstorm from	109	events
0.000	t ac^{-1}	upland erosion rate (0 kg m^{-2})		
0.000	t ac^{-1}	sediment leaving profile (0.006 kg m^{-1} width)		

Return period analysis based on 30 years of climate

Return Period	Precipitation (in.)	Runoff (in.)	Erosion (t ac^{-1})	Sediment (t ac^{-1})
30 year	49.53	6.65	0.01	0.0147
15 year	41.74	3.11	0.01	0.0112
6 year	37.69	2.41	0.00	0.0001
3 year	35.20	1.21	0.00	0.0000
1.5 year	31.75	0.11	0.00	0.0000
Average	33.51	1.00	0.00	0.0000

Figure 2. Screen Capture of Inputs and Outputs in Disturbed WEPP for Falls Creek groundbased harvest Units

Table 3. WEPP:Road Inputs for 3 Green Horse Project Roads

Road #	Road Design	Road Surface	Traffic Level	Road Gradient	Road Length	Road Width	Fill Gradient %	Fill Length (ft)	Buffer Gradient	Rock Fragment	Buffer Length
2103 (no haul)	IB	N	L	2	50	16	15	20	10	50	20
2103 (xing)	IB	N	L	2	15	16	15	20	10	10	20
2103 (log haul)	IB	N	H	2	50	16	15	20	10	50	20
443 (no haul)	IB	G	L	2	50	16	5	15	10	100	20
443 (log haul)	IB	G	H	2	50	16	5	15	10	100	20
443 (xing log haul)	IB	G	H	2	50	25	5	20	10	200	15
464 (no haul)	IB	G	L	2	50	30	2	20	10	200	15
464 (haul)	IB	G	H	2	50	30	2	20	10	200	15

Table 4. Template from WEPP:Road explaining variable inputs

Road Design	Road Surface	Traffic Level	Road gradient	Road length	Road width	Fill gradient	Fill length	Buffer gradient	Buffer length	Rock Fragment
(ib, iv, or, ou)	(N, G, P)	(H, L, N)	(dec %)	(m or ft)	(m or ft)	(dec %)	(m or ft)	(dec %)	(m or ft)	(dec %)
ib: Inslope, bare	Native	High								
iv: Inslope, veg	Gravel	Low								
or: Outslope, rut	Paved	None								
ou: Outslope, unrut										

Table 5. WEPP:Road Outputs for 3 Green Horse Project Roads

Road #	Average annual rain runoff (in)	Average annual snow runoff (in)	Average annual sediment leaving road (lb)	Average annual sediment leaving buffer (lb) (per 50’ rd segment)
2103 (no haul)	0.1	0.0	20	3
2103 (xing)	0.1	0.0	6	1
2103 (log haul)	0.1	0.0	66	5
443 (no haul)	0.0	0.0	11	1
443 (log haul)	0.0	0.0	34	2
443 (xing log haul)	0.0	0.0	56	3
464 (no haul)	0.0	0.0	21	1
464 (haul)	0.0	0.0	67	3

Screen captures of what the WEPP Road input and out looks like follow in Figure 3.

[5] -- 443 Project Rd Seg, Log haul

[6] -- 443 Xing-Log Hau

[7] -- 446 No Haul

[8] -- 446 Log Haul

Green Horse

ElkCityID +
Modified by Rock:Clime on August 31, 2020 from FENN RS ID 103143 0
T MAX 35.45 42.78 50.69 61.34 70.27 78.31 88.83 88.66 76.43 60.76 44.95 36.85 deg F
T MIN 22.73 26.78 30.14 35.15 41.30 47.68 51.17 50.14 44.09 36.55 30.74 25.51 deg F
MEANP 3.72 2.64 2.86 2.70 3.24 3.10 1.48 1.59 2.06 2.07 3.00 3.41 in
# WET 16.17 13.18 15.06 13.52 12.96 11.47 5.93 6.11 7.64 9.84 15.00 15.50
LATT= 45.83 LONG= 115.44 ELEVATION = 4605.0 ft

silt loam soil	30 year run
Average annual precipitation 33 in	

[Help copying output to a spreadsheet]

Run number	Design	Surface, traffic	Road grad (%)	Road length (ft)	Road width (ft)	Fill grad (%)	Fill length (ft)	Buff grad (%)	Buff length (ft)	Rock cont (%)	Average annual rain runoff (in)	Average annual snow runoff (in)	Average annual sediment leaving road (lb)	Average annual sediment leaving buffer (lb)	Comment
1	Insloped, bare ditch	native low	2	50	16	15	20	10	50	20	0.1	0.0	20	3	2103 Typical-no traffic
2	Insloped, bare ditch	native low	2	15	16	15	20	10	10	20	0.1	0.0	6	1	2103 xing
3	Insloped, bare ditch	native high	2	50	16	15	20	10	50	20	0.1	0.0	66	5	2103 traffic
4	Insloped, bare ditch	graveled low	2	50	16	5	15	10	100	20	0.0	0.0	11	1	443 Project Rd Seg, no haul
5	Insloped, bare ditch	graveled high	2	50	16	5	15	10	100	20	0.0	0.0	34	2	443 Project Rd Seg, Log haul
6	Insloped, bare ditch	graveled high	2	50	25	5	20	10	200	15	0.0	0.0	56	3	443 Xing-Log Hau
7	Insloped, bare ditch	graveled low	2	50	30	2	20	10	200	15	0.0	0.0	21	1	446 No Haul
8	Insloped, bare ditch	graveled high	2	50	30	2	20	10	200	15	0.0	0.0	67	3	446 Log Haul

Figure 3. Screen Capture of WEPP Road Input and Output

WEPP Results:

Harvest Areas: Disturbed WEPP results predict very little erosion off of a typical harvest unit using the input values for % ground cover following harvest from Elliot and Miller 2017, as well as the local soil and climate information for the sites. Harvest systems on the Nez Perce-Clearwater do leave ground cover and by both Design Criteria and Standard Contract provisions require some retention of large woody debris and clumps of standing trees. For erosion predictions in WEPP, ground cover is a primary control on erosion predictions and based on the Forest's BMP monitoring, surface erosion doesn't appear to occur within harvest units from removal of trees unless there are skid trails, swing trails, or compacted soils that concentrate runoff pathways to create erosion. Design Criteria require that all skid and swing trails are decompacted and mulched with natural mulch at the end of project work to prevent this kind of erosion. Over the last few decades considerable research explores the potential for erosion from different harvest systems ranging from Steinbrenner and Gessel 1955, to locally relevant research focused on harvest impacts to the ash soils here (Page-Dumroese et al 2007), to more recent research such as Reeves *et al* 2011 and Wagenbrenner *et al* 2015. Mitigation measues that limit number of passes for skid trails and require rehab through decompation and placement of slash material on skid and swing trails reduces erosion and should prevent connectivity between the unit and live water (Elliot et al. 2000). Both WEPP model results and on Forest observational monitoring (NPC,Smith 2016) concur that when riparian buffers are left in place, the vegetation appears to buffer delivery of sediment into streams.

Road Results: WEPP:Road results can be variable depending on road segment length and gradient. The results above are for two of the typical high standard logging roads FSR #443 and #446 and allow comparison of how higher log traffic may influence the buffer length. And, FSR#2103 is a typical lower standard road in the project with native surface with the same comparisons and adding in a stream crossing where there would be less buffer between the road and live water. WEPP road is not a calibrated model on the Forest and results should be understand as a way to understand relative effects of different project activities on water quality rather than absolute quantities of sediment delivery. The results above equate to hundredths and thousands of tons per mile of sedimentation. Elliot and Miller (2017) found on similar roads in the proposed Clear Creek project area, though with much steeper slopes, estimated erosions rates were closer to 4.9 tons/mile to 12 tons/mi^2 which compared to NEZSED values of 2.2 tons/mi^2 although NEZSED models a higher proportion of sediment delivery to streams than WEPP for that particular study. Table 6 below details characteristics of the Green Horse project's proposed log haul roads that constitute risk factors for road-associated sedimentation: surfacing (gravel vs. native), proximity to riparian areas, stream crossings, etc. The Project File contains the summarized field data from road surveys. As with Disturbed WEPP, WEPP:Road assumes riparian buffers of 50' or more are effective for filtering out surface erosion from roads. All roads were not run separately in WEPP given they are modeled in NEZSED, in general erosion rates for roads vary between 2 and 5 tons/mile depending on surfacing, size of road, and topography with WEPP:Road showing very little to no delivery where riparian buffers are in place.

Table 6. Summary of Green Horse Roads with Proposed Log Haul

Drainage- HUC 12	Forest Road #	Miles	Log Haul (Y/N)	Surface Type	RHCA (miles)	Road - Stream Crossings	Miles on LSP	Notes
Ohara Creek	2103	3.1	Y	Native	0.05	2		
	356	3.0	Y	Gravel		0		
	464	1.5	Y	Gravel				
	464A	0.8	Y	Gravel				
Glover Creek-Selway River	2103	0.0	Y	Native	0.05	1		
	356	0.7	Y	Native		0		
	443	1.4	Y	Gravel				In project area, close to ridge active ditch, no perennial streams
	464	1.0	Y	Gravel				Close to ridge, multiple crossings with intermittent headwaters and active ditch, no perennial streams
	9704	0.0	Y	Gravel				
	9713	0.6	Y	Native			0.5	
	9714	5.3	Y	Gravel	0.4	12	0.85	Field visit noted numerous existing fill failures at stream crossings. Gravel in poor condition.
	9714B	0.4	Y	Native		2	0.3	
	9715	3.2	Y	Native	0.1	3		Crossings are not on haul route
	9716	5.3	Y	Gravel		2		Gravel powdery
	9716A	2.1	Y	Gravel	0.25	6		
Horse Creek	2116	4.8	Y	Gravel		7		
	443	5.2	Y	Gravel				
	464	0.0	Y	Gravel				

	9704	1.0	Y	Gravel				
	9714	0.0	Y	Gravel				
Upper American River	1125	0.0	Y	Gravel				
	356	0.0	Y	Gravel				
	443	5.5	Y	Gravel				

1.2.3.2 NEZSED

The NEZSED output is included in the Effects Analysis document. The inputs and outputs are best understood by reviewing the calculations spreadsheet included in the project file.

1.2.4 Model Uncertainties

1.2.4.1 WEPP

The physical basis and performance of the WEPP models is discussed in the model documentation (Elliot et al. 2000, Elliot 2004, Robichaud et al. 2007) as well as several peer-reviewed papers (Elliot 2004, Laflen et al. 2004, Larsen and MacDonald 2007). In general, erosion prediction models have difficulty predicting sediment output with precision from a road, hillslope, or watershed at time scales useful to land managers. This is due mainly to a high degree of variability in site characteristics and climate. An average erosion/sediment delivery rate prediction can encompass this variability to some degree but is more useful when combined with a probability that erosion would occur.

The WEPP models incorporate climate data tailored to the individual site using Parameter-elevation Regressions on Independent Slopes Model (PRISM) data (Daly et al. 2000) and simulate daily events for a number of years specified by the user (100 years in this analysis) to determine the probability of sediment leaving the modeled hillslope. The model incorporates individual precipitation event characteristics and antecedent conditions as well as site characteristics into its prediction of average annual runoff, erosion, and sediment yield values.

Accurately predicting erosion is difficult and subject to large errors from various sources because of highly complex processes including spatial variation in slope, soil, and vegetative conditions, and uncertainty in precipitation (Walling 1988). Therefore, applying hillslope estimates across landscapes and watersheds generalizes actual rates of erosion that may occur. Modeled erosion and sedimentation rates are recognized as highly variable. Neary et al. (2005) suggest that the average erosion value produced by a model is likely to be plus or minus 50% of the observed value.

1.2.4.2 NEZSED

Gerhardt 2006 summarizes the efforts to validate (and calibrate) the NEZSED Model. The report summary is included as an Appendix in the Conroy and Thompson 2001 Appendix A guidance.

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